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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/618,024	07/11/2003	Robert P. Vaudo	ATMI-661	4023

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INTELLECTUAL PROPERTY / TECHNOLOGY LAW
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EXAMINER	
COLEMAN, WILLIAM D	

ART UNIT	PAPER NUMBER
2823	

DATE MAILED: 07/17/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/618,024	VAUDO ET AL.	
	Examiner	Art Unit	
	W. David Coleman	2823	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *10 May 2006*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-116* is/are pending in the application.

4a) Of the above claim(s) *42-116* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-41* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *05/06*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Response to Arguments

1. Applicant's arguments filed May 10, 2006 have been fully considered but they are not persuasive.

2. In response to applicant's argument that the references fail to show certain features of applicant's invention, it is noted that the features upon which applicant relies (i.e., semi-insulators being characterized by bulk resistivity between 10^3 to 10^{10} ohm centimeters) are not recited in the rejected claim(s). Although the claims are interpreted in light of the specification, limitations from the specification are not read into the claims. See *In re Van Geuns*, 988 F.2d 1181, 26 USPQ2d 1057 (Fed. Cir. 1993).

3. With respect to the term "semi-insulating", it is merely an equivalent term to "semi-conductive" the term "insulating" is well known to mean not conductive and the term "semi-insulating" to mean not totally insulative. The term "semi-conductive" is well known in the art to mean not totally conductive and would suggest some insulative quality. It is well known in the art that semiconductors are semi-insulative and therefore Applicants arguments are moot. In column 6, lines 36-37 Cho specifically discloses a GaN semiconductor crystal and is silent as to the crystal being n-type or p-type. Cho discloses that the donor concentration can be as low as 10^{13} (see column 7, lines 8-12) wherein the calculation of rho (ρ=1/q(1.6X10-19 coulombs)X μ_n (hall mobility 300 Vs/cm) X N_D) which would calculate to have a resistivity of $2X10^3$ Ohm centimeters.

Allowable Subject Matter

4. The claims would be allowable if the range of resistivity and dimensions are incorporate in the independent claims.

Claim Rejections - 35 USC § 102

5. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

6. Claims 1, 10, 11, 14, 15, 16, 22, 23, 24, 25, 26, 27, 28, 35 and 36 are rejected under 35 U.S.C. 102(b) as being anticipated by Cho et al., U.S. Patent 6,407,409

7. Cho discloses a semiconductor device as claimed. Please see entire document where Cho teaches the claimed invention.

8. Pertaining to claim 1, Cho teaches a large-area, single-crystal semi-insulating gallium nitride (the dimensions of Cho are approximately 2 inches in diameter, see column 6 lines 40-43 and the donor concentration is as low as 10^{13} per cubic centimeter see column 7, line 11).

9. Pertaining to claim 10, Cho teaches a gallium nitride according to claim 1, as formed by hydride vapor phase epitaxy (HVPE).

10. Pertaining to claim 11, Cho teaches a gallium nitride according to claim 1, with a thickness in a range of from about 50 micrometers to about 5 centimeters (column 6, lines 40-43).

11. Pertaining to claim 14, Cho teaches a gallium nitride according to claim 1, which is free-standing.

12. Pertaining to claim to 15, Cho teaches a gallium nitride according to claim 14, having a diameter of at least 50 millimeters, and a thickness of at least 300 micrometers.

13. Pertaining to claim 16, Cho teaches a gallium nitride according to claim 15, wherein the thickness is in a range of from 300 micrometers to 5 centimeters.

14. Pertaining to claim 22, Cho teaches a gallium nitride according to claim 1, wherein unintentional impurities are less than 5×10^{17} cm^{-3}.

15. Pertaining to claim 23, Cho teaches a gallium nitride according to claim 1, wherein unintentional impurities are less than 1×10^{17} cm^{-3}.

16. Pertaining to claim 24, Cho teaches a gallium nitride according to claim 1, wherein unintentional impurities are less than $5x10^{16}cm^{3}$.

17. Pertaining to claim 25, Cho teaches a gallium nitride according to claim 1, wherein unintentional impurities are less than 1×10^{16} cm^{3}.

18. Pertaining to claim 26, Cho teaches a gallium nitride according to claim 1, having a dislocation defect density not exceeding 10^{7} defects /cm^{2} (see column 8, lines 8-9).

19. Pertaining to claim 27, Cho teaches a gallium nitride according to claim 1, having a dislocation defect density not exceeding 10^{6} defects /cm^{2}.

20. Pertaining to claim 28, Cho teaches a gallium nitride according to claim 1, having a dislocation defect density not exceeding 10^{5} defects /cm^{2}.

21. Pertaining to claim 35, Cho teaches gallium nitride according to claim 1, including microelectronic circuitry fabricated thereon and/or therein, wherein the gallium nitride is semi-insulating in an operating temperature regime of said microelectronic circuitry.

22. Pertaining to claim 36, Cho teaches a gallium nitride according to claim 1, having electronic circuitry fabricated thereon and/or therewithin.

Claim Rejections - 35 USC § 103

23. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

24. Claims 2-12, 17-21, 31-34 and 37-38 are rejected under 35 U.S.C. 103(a) as being unpatentable over Cho et al., U.S. Patent 6,407,409 B2 in view of Heitz et al., "Excited States of Fe3+ in GaN", Physical Review B, vol. 55, no. 7, February 15, 1997, pp 4382-4387.

25. Cho discloses a semiconductor device substantially as claimed. However, Cho fails to disclose the various limitations recited below.

26. Pertaining to claim 2,Cho fails to teach a gallium nitride according to claim 1, doped with a transition metal dopant species. Heitz teaches a gallium nitride according to claim 1, doped with a transition metal dopant species to compensate residual donor species in the gallium nitride, wherein the concentration of transition metal dopant species is sufficient to render the gallium nitride semi-insulating. In view of Heitz, it would have been obvious to one of ordinary skill in the art to teach compensate residual donor species because a donor species creates a semi-insulating GaN (see introduction).

27. Pertaining to claim 3, Cho in view of Heitz teaches gallium nitride according to claim 2, wherein the transition metal dopant species comprises at least one transition metal selected from

the group consisting of Cr, Mo, W, Mn, Re, Fe, Ru, Os, Co, Rh, Ir, Ni, Pd, Pt, Cu, Ag, Au, Zn, Cd and Hg.

28. Pertaining to claim 4, Cho in view of Heitz teaches a gallium nitride according to claim 2, wherein the transition metal dopant species comprises at least one transition metal selected from the group consisting of Mn, Fe, Co, Ni and Cu.

29. Pertaining to claim 5, Cho in view of Heitz teaches a gallium nitride according to claim 2, wherein the transition metal dopant species comprises manganese.

30. Pertaining to claim 6, Cho in view of Heitz teaches a gallium nitride according to claim 2, wherein the transition metal dopant species comprises cobalt (although Heitz does not specifically discloses cobalt, Heitz discloses that Transition Metals form deep defects and it is well known that cobalt is a transition metal).

31. Pertaining to claim 7, Cho in view of Heitz teaches a gallium nitride according to claim 2, wherein the transition metal dopant species comprises nickel.

32. Pertaining to claim 8, Cho in view of Heitz teaches a gallium nitride according to claim 2, wherein the transition metal dopant species comprises copper.

33. Pertaining to claim 9, Cho in view of Heitz teaches a gallium nitride according to claim 2, wherein the transition metal dopant species comprises iron.

34. Pertaining to claim 12, Cho in view of Heitz fails to disclose a gallium nitride according to claim 1, in the form of a boule (because the claims are product claims, no patentable weight is given to the process).

35. Pertaining to claim 13, Cho in view of Heitz fails to disclose a gallium nitride according to claim 12, wherein the boule has a thickness in a range of from about 300 micrometers to about 5 centimeters.

36. Pertaining to claim 17, Cho in view of Heitz fails to disclose a gallium nitride according to claim 1, having a resistivity greater than about 10^2 Ω cm, at 25^0C.

37. Pertaining to claim 18, Cho in view of Heitz fails to disclose a gallium nitride according to claim 1, having a resistivity greater than about 10^5 Ω cm, at 25°C.

38. Pertaining to claim 19, Cho in view of Heitz fails to disclose a gallium nitride according to claim 1, having a resistivity greater than about 10^2 Ω cm, at 200°C.

39. Pertaining to claim 20, Cho in view of Heitz fails to disclose a gallium nitride according to claim 1, having a resistivity greater than about 10^5 Ω cm, at 200°C.

40. Pertaining to claim 21, Cho in view of Heitz fails to disclose a gallium nitride according to claim 1, having a resistivity greater than about 10^5 Ω cm, at 300°C.

41. Pertaining to claim 31, Cho in view of Heitz fails to disclose a gallium nitride according to claim 1, doped with a dopant species to compensate residual donor species in the gallium nitride, wherein the dopant species has an activation energy greater than 0.35 eV.

42. Pertaining to claim 32, Cho in view of Heitz fails to disclose a gallium nitride according to claim 1, doped with a dopant species to compensate residual donor species in the gallium nitride, wherein the dopant species has an activation energy greater than 0.50 eV.

43. Pertaining to claim 33, Cho in view of Heitz fails to disclose a gallium nitride according to claim 1, doped with a dopant species to compensate residual donor species in the gallium nitride, wherein the dopant species has an activation energy greater than 0.75 eV.

44. Pertaining to claim 34, Cho in view of Heitz fails to disclose a gallium nitride according to claim 1, doped with a transition metal dopant species having an activation energy greater than 0.35 eV.

45. Pertaining to claim 37, Heitz in view of Heitz fails to disclose an electronic device structure, comprising gallium nitride as in claim 1, and an electronic device fabricated thereon and/or therewithin.

46. Pertaining to claim 38, Heitz in view of Heitz fails to disclose the electronic device structure of claim 37, wherein the electronic device comprises a high electron mobility transistor (HEMT).

47. Given the teaching of the references, it would have been obvious to determine the optimum thickness, temperature as well as condition of delivery of the layers involved. See *In re Aller, Lacey and Hall* (10 USPQ 233-237) "It is not inventive to discover optimum or workable ranges by routine experimentation. Note that the specification contains no disclosure of either the critical nature of the claimed ranges or any unexpected results arising therefrom. Where patentability is said to be based upon particular chosen dimensions or upon another variable recited in a claim, the Applicant must show that the chosen dimensions are critical. *In re Woodruff*, 919 f.2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

Any differences in the claimed invention and the prior art may be expected to result in some differences in properties. The issue is whether the properties differ to such an extent that the difference is really unexpected. *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986)

Appellants have the burden of explaining the data in any declaration they proffer as evidence of non-obviousness. *Ex parte Ishizaka*, 24 USPQ2d 1621, 1624 (Bd. Pat. App. & Inter. 1992).

An Affidavit or declaration under 37 CFR 1.132 must compare the claimed subject matter with the closest prior art to be effective to rebut a prima facie case of obviousness. *In re Burckel*, 592 F.2d 1175, 201 USPQ 67 (CCPA 1979).

48. Even though product-by-process claims are limited by and defined by the process, determination of patentability is based on the product itself. The patentability of a product does not depend on its method of production. If the product in the product-by-process claim is the same as or obvious from a product of the prior art, the claim is unpatentable even though the prior product was made by a different process. *In re Thorpe*, 777 F.2d 695, 698, 227 USPQ 964, 966 (Fed. Cir. 1985).

49. "The Patent Office bears a lesser burden of proof in making out a case of prima facie obviousness for product-by-process claims because of their peculiar nature: than when a product is claimed by conventional fashion. *In re Fessmann*, 489 F.2d 742, 744, 180 USPQ 324, 326 (CCPA 1974). Once the Examiner provides a rationale tending to show that the claimed product appears to be the same or similar to that of the prior art, although produced by a different process, the burden shifts to Applicant to come forward with evidence establishing an unobvious difference between the claimed product and the prior art product. *In re Marosi*, 710 F.2d 798, 802, 218 USPQ 289, 292 (Fed. Cir. 1983).

50. Pertaining to claim 29, Cho in view of Heitz fails to disclose a gallium nitride according to claim 2, comprising background impurities including silicon and oxygen, wherein said transition metal dopant species comprises iron, and said iron has a concentration that is greater than total concentration of said silicon and said oxygen. However, it would have been obvious that a background impurity of silicon and/or oxygen would render the gallium nitride layer non-

insulating and therefore since Cho and Heitz teaches a semi-insulating the silicon and/or oxygen concentration in the background would be obviously low.

51. Claim 30 is rejected under 35 U.S.C. 103(a) as being unpatentable over Cho et al., U.S. Patent 6,407,409 B2 and Heitz et al., "Excited States of Fe3+ in GaN", Physical Review B, vol. 55, no. 7, February 15, 1997, pp 4382-4387 in view of Heikman et al., "Growth of Fe doped semi-insulating GaN by metalorganic chemical vapor deposition", Applied Physics Letters, vol. 81, no. 3, July 15, 2002, pp 439-441.

52. Pertaining to claim 30, Cho in view of Heitz fails to disclose a gallium nitride according to claim 2, wherein said transition metal dopant species comprises iron, at a concentration in a range of from about 3×10^{16} atoms/cm^3 to about 7×10^{17} atoms/cm^3, as determined by SIMS. Heikman teaches a transition metal dopant species comprises iron, at a concentration in a range of from about 3×10^{16} atoms/cm^3 to about 7×10^{17} atoms/cm^3, as determined by SIMS. In view of Heikman, it would have been obvious to one of ordinary skill in the art to incorporate the limitations of Heikman into the Heitz semiconductor device because iron doping allows for growth of semi-insulating GaN (see Abstract).

53. Claims 39, 40 and 41 are rejected under 35 U.S.C. 103(a) as being unpatentable over Cho et al., U.S. Patent 6,407,409 B2 and Heitz et al., "Excited States of Fe3+ in GaN", Physical Review B, vol. 55, no. 7, February 15, 1997, pp 4382-4387 in view of Cuomo et al., U.S. Patent 6,692,586 B2.

Cho in view of Heitz discloses a semiconductor device substantially as claimed.

54. Pertaining to claim 39, Cho and Heitz fails to disclose the electronic device structure of claim 37, wherein the electronic device comprises a monolithic microwave integrated circuit

(MMIC). Cuomo discloses a monolithic microwave integrated circuit (i.e., space-based communications and high frequency microelectronic devices). In view of Cuomo, it would have been obvious to one of ordinary skill in the art to incorporate the limitations of Cuomo into the Heitz semiconductor device because bulk materials can be used as substrates upon which microelectronic and optical devices are fabricated (column 1, lines 41-42).

55. Pertaining to claim 40, Cho in view of Heitz fails to disclose the electronic device structure of claim 37, wherein said gallium nitride is on a conductive substrate. Cuomo discloses a conductive substrate (column 11, lines 27-39). In view of Cuomo, it would have been obvious to one of ordinary skill in the art to incorporate the limitations of Cuomo into the Heitz semiconductor device because bulk materials can be used as substrates upon which microelectronic and optical devices are fabricated (column 1, lines 41-42).

56. Pertaining to claim 41, Cho in view of Heitz fails to disclose the electronic device structure of claim 40, wherein the electronic device comprises a high power rectifier. Cuomo discloses the electronic device comprising a high power rectifier (high temperature microelectronics). In view of Cuomo, it would have been obvious to one of ordinary skill in the art to incorporate the limitations of Cuomo into the Heitz semiconductor device because bulk materials can be used as substrates upon which microelectronic and optical devices are fabricated.

57. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Kelly et al., "Large Free-Standing GaN Substrates by Hydride Vapor Phase Epitaxy and Laser-Induced Liftoff", Japanese Journal of Applied Physics, vol. 38, (March 1999), Part 2, No. 3A pp. L217-L219.

Conclusion

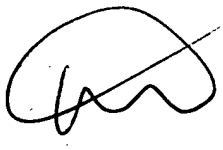
58. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

59. A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

60. Any inquiry concerning this communication or earlier communications from the examiner should be directed to W. David Coleman whose telephone number is 571-272-1856. The examiner can normally be reached on Monday-Friday 9:00 AM - 5:30 PM.

61. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Matt Smith can be reached on 571-272-1907. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

62. Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.



W. David Coleman
Primary Examiner
Art Unit 2823

WDC